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LARGE SCALE PRODUCTION OF THE EGG PARASITE TRICHOGRAMMA MINUTUM RILEY.

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The work on the production of *Trichogramma minutum* Riley was instituted at the Chatham laboratory in January, 1928. What has been done to date has been largely of a preliminary nature but we feel justified in describing the methods being used because of the very general and widespread interest in this insect at the present time.

The production of *Trichogramma* falls naturally into two parts, viz., production of host eggs, and the actual breeding of *Trichogramma*. Under Canadian conditions the former presents the more difficulties and forms perhaps the chief limiting factor in the numbers of this parasite that may be produced.

Of the large number of host eggs attacked by *Trichogramma* (C. H. Martin states 150 species; Entom. Amer., Vol. VIII, No. 3) those of lepidopterous insects attacking stored products seem to be the most suitable for laboratory work and of these *Sitotroga cerealella* Ol. has so far proven the most satisfactory. This species is not an established pest in Canada as it will not withstand our low winter temperatures. It is, therefore, necessary to keep breeding a stock in the incubators throughout the year.

The method of obtaining host eggs is essentially the same as that used by Mr. Stanley Flanders of California, to whom we are indebted for very valuable suggestions as to technique. Our thanks are also due to Dr. W. D. Hinds of Baton Rouge, La., and Mr. D. W. Jones of Arlington, Mass. for the original breeding stock and details of their equipment.

The moths are reared in a specially built incubator, a description of which is given later in this paper. The temperature is maintained at 82 degrees F. and the relative humidity above 50 per cent.,—preferably 70 per cent. Either corn or wheat may be used as food for the moth larvae. Corn produces larger moths and, on recommendation of Mr. Flanders, we have been using white dent corn. This has proven quite satisfactory.

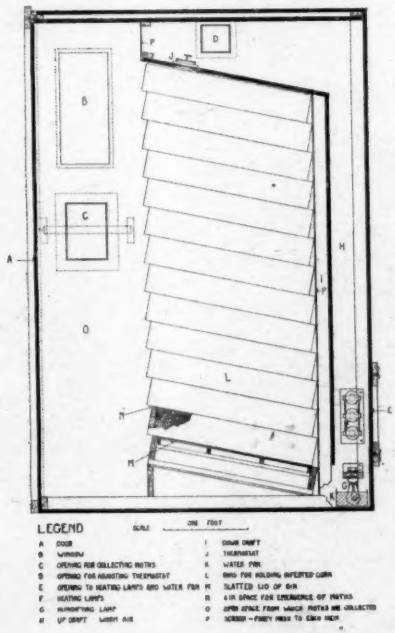
In building up a large infestation of *Sitotroga*, mites present a serious problem. It has been found necessary to superheat all corn before using to insure its being free from them, and to clean out the incubators frequently. The use of several small incubators has been found advisable since one may be emptied and cleaned without seriously interfering with the work.

The moths are collected from the incubators by means of a vacuum collector. The screen in the bottom of the oviposition cage is covered with corn starch in which the moths lay their eggs. This starch is removed from the oviposition cages daily and the eggs separated from it by sifting through a 60 mesh bolting cloth sieve.

The clean eggs are fastened to three inch round paper cards with thin shellac. This card bearing fresh host eggs is now exposed to *Trichogramma* in

a Petri dish which contains half a card of parasitized eggs from which the *Trichogramma* have just started to emerge. The dishes are kept in a temperature of 80 to 83 degrees F. and exposed to moderately strong light from above. In twelve hours this card is removed and a fresh card of eggs placed with the *Trichogramma*. This change is repeated at twelve-hour intervals as long as there is an appreciable number of *Trichogramma* still alive. The changing of the cards requires some care but, with practice it is possible to change them without the loss of many *Trichogramma*. The parasitized eggs are kept at a temperature of 80 to 83 degrees F. and, at this temperature, yield *Trichogramma* in eight and one-half to nine days. Emergence is spread over about a day, but it can be brought on in a shorter period by keeping the parasitized eggs in a dark place and slightly cooler from the beginning of the eighth day and then bringing them to bright light and incubator temperatures at the beginning of the tenth day. The *Trichogramma* then all emerge in about an hour.

INCUBATOR FOR PRODUCTION OF SITOTROGA MOTHS



SITOTROGA INCUBATOR

This is built of 'Celotex' and is drawn with one side removed to show the details of interior construction. The door (A) may be removed for changing the bins.

The bins (L) are of dressed lumber 2 feet by 2 feet by 4 inches deep. The covers are made of narrow slats placed one-eighth inches apart and running from back to front. The covers are flush with the front and back of the bins, which are one-eighth inch lower than the sides.

Heat is supplied by a bank of carbon lamps (F) controlled by the thermostat (J). The water-pan (K) provides humidity and evaporation is increased by having a carbon lamp immersed in the water. (P) represents 40-mesh screen. The circulation of heated air is as follows: up the space (H), through the screen into the space (O), through the one-eighth inch spaces between the trays and down the space (I). (C) is a door through which the moths are collected.

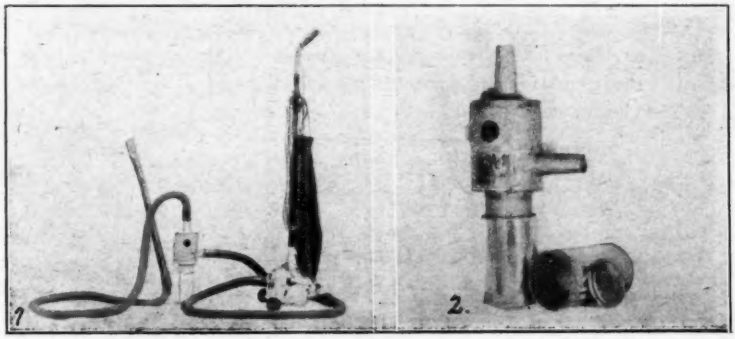


Fig. 1. Vacuum-collector assembly. Fig. 2. Collecting can and oviposition cage.

VACUUM COLLECTOR

(Figures 1, 2 and 3.)

Figure 1 shows the vacuum collector assembly, consisting of ordinary vacuum sweeper, collecting can, oviposition cage in place on collector, hose connections, and nozzle. Figure 2 shows a closer view of collecting can with oviposition cage attached. Figure 3 shows the details of the collecting can. The

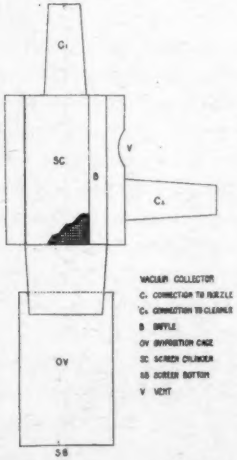


Fig. 3. Details of collecting can.

moths enter by (C 1), the screen cylinder (S C) prevents them going into the vacuum cleaner through (C 2), they drop down into the oviposition cage (O V).

(B) is a piece of tin which acts as a baffle plate preventing the draft being too strong directly opposite the sucking connection (C 2). (V) represents one of the two adjustable vents in the outside, which are used to adjust the velocity of the suction.

OVIPOSITION CAGES

The size of these cages must be adapted to the number of moths used. The one represented has been found satisfactory for numbers of moths up to five hundred. It consists of a can 3¼ inches in diameter and 5½ inches high. The top has a removable lid allowing the cage to be attached to the vacuum collector. The bottom is made of 20-mesh bronze screen. When in use the cage sits in a petri dish cover in which is enough corn starch to press up through the screen sufficiently to cover it.

STUDIES ON HISTERIDAE (COLEOP).

BY MELVILLE H. HATCH,*

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Hister L.

Interruptus Group.

Hister jaquesi n. sp.

I take pleasure in naming this species and an hereinafter to be described species of *Saprinus* after Prof. H. E. Jaques of the Iowa Wesleyan College. The present paper is the result of the studies necessitated by the specimens of Histeridae sent to me by Prof. Jaques for determination. The types of all the new species and aberrations are in the collection of the author.

Length 4.2 mm.; width 3.2 mm. This species almost exactly resembles *interruptus* Beauv., the differences between it and that species and *stygicus* Lec. being set forth in the following table. Type: Mt. Pleasant, Ia May 20, 1925, Bowie.

A1. Mesosternum strongly emarginate at apex; propygidium and pygidium coarsely densely punctate; front without impressed puncture; prosternum incompletely margined at apex, the sides of the ridge finely sparsely punctate; length 5-8 mm. ..... *interruptus* Beauv.

A2. Mesosternum very feebly emarginate at apex.

B1. Propygidium and pygidium coarsely densely punctate; front without impressed puncture; prosternum completely margined at apex, the sides of the ridge coarsely punctate; length 4.2 mm.; Iowa .... *jaquesi* n. sp.

B2. Propygidium coarsely sparsely punctate, pygidium finely sparsely punctate; front with impressed puncture; length 2.5 mm.; Ga., Ind. .... *stygicus* Lec.

Abbreviatus Group.

Hister abbreviatus F.—From the description I suspect that *coloradensis* Csy. (Mem. Col. XI, 1924, p. 198) is a synonym. At most it is no more than a subspecies.

*—Contribution from the Zoological Laboratory of the University of Washington.

Subg. *Atholus* Thoms.

Hister (Atholus) laevicaudoides n. sp.

Length 3.8 mm.; width 3 mm. Shining black. Finely sparsely punctulate. Pronotum with outer thoracic stria fine, entire except for a brief distance just behind middle; internal thoracic stria coarse, entire. Elytral striae impunctate. Hypomera bistriate. Humeral fine, subhumeral absent. First to third dorsals entire. Fourth dorsal continued behind base by a series of fine striae and punctures. Fifth dorsal represented by two or three fine punctures caudad. Sutural stria extending in front of middle. Propygidium and pygidium uniformly coarsely punctate. Protibia quinti-dentate, the distal tooth greatly elongate and bifid. Type: Riley Co., Kans. Mar. 21.

This and the other species related to *nubilus* and *pollutus* Lec. may be distinguished as follows:

A1. Fifth dorsal stria apical; fourth dorsal entire; external thoracic stria apical; protibia quadri-dentate; Kans ..... *nubilus* Lec.

A2. Fifth dorsal obsolete; fourth dorsal more or less broken up or obsolete apically.

B1. Fourth dorsal represented apically by a series of striae or punctures.

C1. First protibial tooth not greatly larger than the penultimate one; external thoracic stria apical.

D1. Protibia tridentate; length 3.7 mm.; Tex ..... *abducens* Csy.

D2. Protibia quadridentate; length 3.8-4.0 mm.; Mo., Miss .... *fluviatilis* Csy.

D3. Protibia quintidentate; length 4.4 mm.; Tex. ..... *vestigialis* Csy.

C2. First protibial tooth greatly larger than the penultimate one.

D1. Propygidium and pygidium uniformly coarsely punctate; outer thoracic stria entire except for brief interruption just behind middle, fine; protibia quinti-dentate, the distal tooth bifid, the two basal teeth minute; length 3.8 mm.; Kans. ..... *laevicaudoides* n. sp.

D2. Propygidium more finely punctate at middle; pygidium more finely punctate towards base; outer thoracic stria not extending half way to base; protibia quadridentate, the distal one not evidently bifid, the basal one minute; length 3.8-4.2 mm.; Kans. . .*laevicauda* Csy.

B2. Fourth dorsal present only at base; protibia quadridentate, the apical tooth slightly more prominent than anteapical, bifid; outer thoracic stria extending onto basal half, fine; length 4.5 mm.; Kans .... *pollutus* Lec.

Saprinus Er.

Group V of Horn.

The species of Horn's Group V (Proc. Am. Phil Soc. XIII, 1873, p. 320) with inflexed portion of elytra bistriate, the sutural stria present at apex and middle, the surface piceous or slightly bronzed, the elytra aciculately densely punctate at apex may be separated as follows:

A1. Interval between inner subhumeral and first dorsal broad; sutural stria obsolete at base, not joined with fourth dorsal.

B1. Interval between inner subhumeral and first dorsal with about three rows of coarse punctures; first dorsal interval coarsely punctate; the

punctation of the other intervals variable; the inner subhumeral stria and the impression at the anterior angle of the pronotum less distinct; N.Y., Ont., and Ind. to N.M., Mex., Cal., Wash. and Alta. .. *lugens* Er.

B2. Interval between inner subhumeral and first dorsal stria and the second and third dorsal intervals finely punctulate; the coarse punctures of the first dorsal interval replaced by a series of oblique furrows; the inner subhumeral stria and the impressions at the anterior angles of the pronotum more distinct; the inner subhumeral and oblique humeral continuous; Ia., Mich. N.J., Pa., Va., N.C., La. ..... *lecontei* Csy.

A2. Interval between inner subhumeral and first dorsal narrow, with one row of coarse punctures (rarely extremely faint or with an additional row of fine punctures); punctation of the dorsal intervals variable; inner subhumeral stria distinct; impressions at anterior angles of pronotum faint; sutural stria joined or not joined to fourth dorsal stria at base, present or absent at base; N.Y., Conn. and N.J. to Mich., Wisc., Colo., N.M., Calif., Wash. and Alta. ..... *oregonensis* Lec.

The characters given by Horn for the separation of these species are worthless because of their variability. The continuity of the inner subhumeral and oblique humeral striae, mentioned by Casey, is similarly unreliable. In both this respect and in respect to the continuous or discontinuous fourth dorsal and sutural stria, I have specimens of *oregonensis* exhibiting one condition on one *elytron*, the other condition on the other. If my characters should eventually prove similarly worthless, I see no other alternative than to unite the three species as one.

Saprinus lugens Er.—This species presents a series of aberrations more or less analogous to those present in *oregonensis* Lec., which may be distinguished and named as follows:

A1. All dorsal intervals coarsely punctate; Cal., Mex. ..... *type.*

A2. Inner half of third interval finely punctate; Calif. (Type: Laguna Beach, July, 1915, W. A. Riley) ..... ab. *oregonensoides* nov.

A3. Inner half of second and entire third interval finely punctate; Mich. (type Cheboygan Co., Douglas Lake, vii-1-1920. M. H. Hatch, 920 o .... ab. *distinguendoides* nov.

A4. Entire second and third intervals finely punctate; Iowa (Type: Dickinson Co., July 31, 1920, Betty Rogers). ..... ab *sejunctoides* nov.

The fourth dorsal stria varies from a distinctly arcuate condition to one not at all arcuate.

Saprinus lecontei Csy. (Mem. Col. VII, 1916, p. 262)—Casey made two errors: (1) in such specimens as I have seen the disc of the pronotum is finely punctulate, not impunctate; (2) the impressions at the anterior angles of the pronotum are feebly developed in *oregonensis* Lec., not absent.

Saprinus oregonensis Lec.—The aberrations may be distinguished and named as follows:

A1. Sutural stria entire and joining fourth dorsal.

B1. All dorsal intervals coarsely punctate except inner half of third; Mich., Man. ..... *type.*

B2. Entire third dorsal interval and inner half of second finely punctate; Mich., Man. ..... ab. *distinguendus* Mars.

B3. Entire second and third intervals finely punctate: Calif. (Type: San Diego, L. E. Ricksecker). ..... ab. *pseudosejunctoides* nov.

B4. All dorsal intervals finely punctate Wash. (Type: Springdale, vii-19-1920, F.N.B. 1089). ..... ab. *pseudosejunctus* nov.

A2. Sutural stria obsolete at base, not joining fourth dorsal.

B1. Entire third dorsal interval and inner half of second finely punctate; Man. (Type: Aweme, vii-20-1918). .... ab. *pseudodistinguendus* nov.

B2. Entire third and second dorsal intervals finely punctate; Colo. (Type: Salida, July 20). ..... ab. *leconteoides* nov.

B3. All dorsal intervals finely punctate; Man. ..... ab. *sejunctus* Mars.

Saprinus pennsylvanicus Payk.—Three phases of this species seem to exist, as follows:

A1. Sutural stria entire.

B1. Pygidium uniformly punctate, unmodified; Fla., N.J. ..... *type.*

B2. Pygidium with apex feebly carinate, the semi-impunctate areas absent or feebly developed, the sides not too evidently sulcate; Mich. (Type: Washtenaw Co., Portage L.; viii-1-1918; M. H. Hatch, 320g), Ohio, N.J. ..... ab. *profusoides* nov.

A2. Sutural stria absent at base; pygidium with a more or less strongly developed semi--impunctate area on either side, the apex feebly carinate, the side sulcate; Tex., Ohio ..... ab. *profusus* Csy.

The frontal stria varies from entire to nearly obsolescent.

Assimilis Group.

Saprinus assimilis Payk.—Specimens with the marginal sulcus of the pygidium interrupted at the apex may be termed ab. *semisulcus* nov. (Type: Cheboygan Co., Mich. Douglas Lake, vii-15-1917, M. H. Hatch. 154c); also from Ohio and Iowa.

Subg. *Hypocaccus* Thoms.

Rugifrons Group.

Reichardt (Ent. Blatt. XXII, 1926, p. 14) limits *Hypocaccus* Thoms. to those species of *Saprinus* with the front of the head with an entire margin and one or two transverse wrinkles, the disc of the pronotum punctate, never with both the prothoracic and meso- and metathoracic epipleurae pubescent. The European and Nearctic species of this subgenus in which the elytral punctures are confined to the apex and do not attain the elytral base are defined in the following key.

A1. Margins of pronotum not fimbriate.

B1. Sutural stria present at apex and base, often entire.

C1. Punctate area of elytra extending along suture more than ¾ of distance to base; punctures coarse.

D1. Apical coarsely punctate areas of pronotum extensive, narrowly separated from margin; elytral punctate area extending to second dorsal; length 2.5-3.8 mm.; south Europe ..... *apricarius* Er.

E1. Sutural stria joining fourth dorsal ..... *type.*

E2. Sutural stria joining third dorsal; France .... var. *radiosus* Mars.

D2. Apical coarsely punctate areas of pronotum reduced, distantly separated from margins; elytral punctate area extending to third dorsal; length 3-4.2 mm.; Conn. and D. C. to Kans. and Ia. .... *patruelis* Lec.

C2. Punctate area of elytra extending less than 2/3 of distance to base; punctures finer.

D1. Margin of pronotum more coarsely punctate than disc.

E1. Smooth discal area of pronotum extensive.

F1. Punctate area of elytra separated from apex along suture by a distance of less than 1/5 the length of the elytron.

G1. Punctate area extending to level of second dorsal and nearly to apex.

H1. First dorsal stria entire or nearly so.

I1. Metallic green, rarely black or brown; sutural and first dorsal entire; length 2.5-3.5 mm.; Europe *metallicus* Hbst.

I2. Metallic cupreous; sutural and first dorsal striae entire or briefly interrupted towards apex; punctures dense, tending to form furrows, approximate to tips of dorsal striae; length 3.6 mm.; Mich., Ohio .... *eriensis* n. sp.

H2. First dorsal abbreviated at apex.

I1. Protibia with six similar small teeth; meso- and metathorax not pubescent at sides below; length 2.5-3.5 mm.; Europe ..... *rugifrons* Payk.

I2. Protibia with three large and two small teeth; meso- and metathorax pubescent at sides below; length 2.8-3.8 mm.; France, Spain, Italy ..... *crassipes* Er.

G2. Punctate area extending to third dorsal stria, the punctures sparse, not tending to form furrows, distant from tips of dorsal striae; sutural stria briefly interrupted towards apex; length 3.4 mm.; Ont. ..... *ontarioensis* n. sp.

G3. Punctate area extending to fourth dorsal stria; sutural stria entire.

H1. Elytral striae impunctate; length 2.5-3.5 mm.; Canada to Ind. and Fla. ..... *sphaeroides* Lec.*

H2. Elytral striae punctate; length 2.65-2.8 mm.; Tex .... *divulsus* Csy.

F2. Punctate area separated from apex of elytron along suture by a distance of 1/5 the length of the elytron so that it does not extend caudad of the tip of the anterior portion of the interrupted sutural stria.

G1. Punctured area extending to between third and fourth dorsal striae; length 3.2-3.4 mm.; Mich., Ohio, N.J. *ohioensis* n. sp.

*—Closely allied or identical is *sparsus* Csy. from Florida, length 2.15-2.3 mm., with longer pronotum, smaller pygidium, more elongate prosternal striae.

G2. Punctate area extending about 2/3 the way to the fourth dorsal stria; length 2.8-3.5 mm.; Mich. *michiganensis* n. sp.

E2. Smooth discal area of pronotum reduced to small area at middle of base; length 4.5.; Ill. ..... *illinoensis* Wolc.

D2. Pronotum uniformly finely punctate; length 4.2 mm.; Ind. ..... *lakensis* Blatch.

B2. Sutural stria obsolete apically; punctured area enclosing tips of dorsal striae.

C1. Pronotum strigoso-punctate at apex and sides.

D1. Elytra densely coarsely punctate at apex; bronze; external subhumeral distinct from marginal; the fourth dorsal joining the sutural and impressed; length 3 mm.; Neb., Ind. ..... *seminitens* Lec.

D2. Elytra finely, not densely punctate at apex; viridi-aeneocupreous with the dull punctate areas bluish; external subhumeral not distinct from marginal; the fourth sutural not or feebly joining the sutural; length (to elytral apex) 3.1 mm.; Man. ..... *iris* Fall.

C2. Pronotum sparsely punctured at sides; elytra sparsely punctate.

D1. Elytral striae distinct, crenulate; length 2.25 mm.; Tex. ..... *ferrugineus* Mars.

D2. Elytral striae fine, finely punctulate; sutural stria except at base an unimpressed series of fine punctures; length 2.9-3.1 mm.; Fla. ..... *lustrans* Csy.

B3. Sutural stria obsolete; punctate area enclosing tips of dorsal striae; sides and apex of pronotum strigoso-punctate; length 2.8 mm.; Iowa ..... *jaquesi* n. sp.

A2. Margin of pronotum fimbriate (the hairs easily lost); pronotum nearly uniformly coarsely strigosely punctate, with the punctures obscurely smaller or obsolete towards scutellum; prosternum narrowly compresso-carinate.

B1. Sutural stria fine but entire; punctate area extending more than half way to base.

C1. Punctate area extending less than 3/5 of distance to base; punctures dense; length 2 4 mm.; Cal. ..... *propensoides* n. sp.

C2. Punctate area extending 2/3 of distance to base; punctures sparse and fine; length 2 mm.; Tex. ..... *servilis* Csy.

C3. Punctate area extending 3/4 of distance to base; length 1.9 mm.; Cal. ..... *propensus* Csy.

B2. Sutural stria abbreviated caudad; punctate area extending less than half way to base.

C1. Elytral punctures distinct.

D1. Prosternal ridge acute; length 2.5 mm.; Cal. ..... *lucidulus* Lec.*

D2. Prosternal ridge broader, bistriate; length 2.35-3.2 mm.; Cal. ..... *diego* Csy.

*—Closely related or identical is *recticollis* Csy. from Cal., length 2.65-3.3 mm., with the transverse furrows of the head more distinct, the pronotum with longer and straighter sides and with coarser sculpture, the elytral and pygidial punctures sparser, the body broader.

C2. Elytral punctures minute, sparse, in part obsolescent.

D1. Black; length 2.8; Cal. ..... *obsolescens* Csy.

D2. Rufous; length 2.2-2.65 mm.; Cal. ..... *rubidulus* Csy.

Saprinus (Hypocaccus) eriensis n. sp.

Length 3.6 mm.; width 2.6 mm. Black. Front with feeble transverse wrinkle. Pronotum with sides and apex, except at very middle, margined; narrowly coarsely punctate at base; disc impunctate caudad, evidently puncto-rugose towards apical margin, gradually becoming coarsely puncto-striate laterad. Elytral striae impunctate. Hypomeron unistriate except briefly cephalad where it is bistriate. Inner and oblique subhumerals discontinuous. First dorsal nearly entire (type) or interrupted at apex, curved at apex; second to fourth dorsals subequal, extending about 70% of distance to apex. Fourth dorsal joining sutural, which is interrupted for 12% to 16% of the elytral length at a distance of 12% from its apex (type) or entire (both conditions found on opposite sides of the same specimen). Elytra impunctate except for coarsely densely subrugoso-punctate area which is approximate to suture, extending along it from apical 12% to apical 50%, and lateral nearly to level of second dorsal. Propygidium and pygidium densely punctate except at base, the latter more finely punctate at apex. Prosternum bistriate, the striae abbreviated in front. Protibia octotuberculate, the distal four or five tubercles dentiform. Type: Monroe Co., Mich. Stoney Cr. vii-4-1919. M. H. Hatch 579k. Two paratypes from Cedar Pt., Ohio. Jaques.

Saprinus (Hypocaccus) ontaricensis n. sp.

Length 3.4 mm.; width 2.6 mm. Black. Front as in *eriensis*. Pronotum with sides and apex margined; narrowly coarsely punctate at base except at extreme sides; disc impunctate caudad, very feebly rugose towards apical margin, this rugosity gradually giving way to a sculpture of longitudinal striolae towards the sides, the striolae being separated from the margin by a narrow more feebly sculptured area. Elytral striae impunctate. Hypomeron as in *eriensis*. Inner and oblique subhumerals fine, discontinuous, the latter paralleling the first dorsal. First dorsal extending 70%, second to fourth dorsals subequal, extending 60% of distance to apex. Fourth dorsal joining sutural, which is interrupted for about 8% of elytral length at 12% of distance from apex. Elytra impunctate except for sparsely coarsely punctate area, definitely separated from sutural stria, extending along suture from apical 40% to apical 6% and laterad to level of third dorsal stria. Propygidium and pygidium finely punctate, the former impunctate along base, the latter almost micropunctate at apex. Prosternum bistriate, the striae not attaining apex. Protibia hexadentate. Type: North Bay, Ont. 9 June '05. J. C. Bradley.

Saprinus (Hypocaccus) ohioensis n. sp.

Length 3.2 (type)-3.4 mm.; width 2.3 (type)-2.4 mm. Similar to *michiganensis* except as regards extent of punctate area which is approximate to sutural stria, extending along it from apical 30% to basal 40% and laterad to a level that is intermediate between the third and fourth dorsal striae. Type: Berrien Co., Mich. E. K. Warren Presrv. Sawyer Dunes. VI-14-1920. M. H. Hatch. 790h. Paratypes: Cedar Pt., O. Jaques and 3 labeled Morgan, N.J. Ed. A. Bishoff Collection.

Saprinus (Hypocaccus) michiganensis n. sp.

Length 2.8-3.5 (type) mm.; width 2.4-2.6 (type) mm. Polished metallic cupreous. Front with evident transverse wrinkle. Pronotum margined at apex and sides; narrowly coarsely punctate at base except towards posterior angles: disc impunctate at base, evidently rugoso-punctate towards apical and lateral margins, the punctation feebler towards the posterior angles. Elytral striae impunctate. Hypomeron and humerals as in *criensis*. First dorsal attaining about 4/5 of distance to apex (type), longer or shorter in paratypes; second to fourth dorsals subequal or gradually decreasing in length, attaining about 3/4 of distance to apex (in type the fourth dorsal attains 2/5 of distance to apex); fourth dorsal joining sutural which is interrupted at apical 6% to 12% (type) for about 8% (type) to 16% the elytral length. Punctate area approximate to suture, extending along it from basal 40% to apical 20% and laterad about 3/4 the distance to the level of the first dorsal stria. Propygidium and pygidium finely densely punctate, the latter with finer punctures at apex. Prosternum bistriate, the striae abbreviated before apex. Protibia hexandentate. Type: Berrien Co., Mich. E. K. Warren Presrv. Sawyer Dunes. VI-18-1920. M. H. Hatch 832d. Three paratypes same data as type except: (1) 832e, (2) VI-14-1920, 790i, (3) L. Mich. VI-14-1920, 795e.

Saprinus (Hypocaccus) jaquesi n. sp.

Length 2.8 mm.; width 2.1 mm. Dull black. Front with transverse wrinkle. Pronotum margined at sides and around the frontal lobes; coarsely punctate at base; disc impunctate towards base, feebly puncto-rugose towards apex, gradually becoming evidently rugoso-punctate towards side margins. Elytral striae punctate. Outer subhumeral entire; inner and oblique subhumerals discontinuous. First dorsal extending 90%, second dorsal 80%, third dorsal 65%, fourth dorsal 45% of distance to apex. Fourth dorsal feebly arched at base. Sutural stria obsolete. Punctate area separated from suture by narrow bead, extends from middle to apical 5% and laterad to second dorsal stria; punctures coarse, dense. Propygidium and pygidium more finely densely punctate. Protibia septadentate. Prosternum convex. Type and paratype: Dickinson Co., Ia. July 28, 1926, Betty Rogers.

Saprinus (Hypocaccus) propensoides n. sp.

Length 3.0 mm.; width 2.3 mm. Dark brownish. Front with two distinct transverse arcuate striae. Pronotum margined apically and laterally, the margins with evidence of fimbriation. Entire surface coarsely rugoso-punctate except a feebly indicated less punctate scutellar area. Elytral striae punctate. Hypomeron unistriate. Outer and oblique subhumerals continuous, inner subhumeral approximate to or continuous with oblique subhumeral. First dorsal attaining apical 10%, second and third attaining apical 25%, fourth attaining middle and joining sutural which is interrupted at 2/3 the distance to apex for about 25% the total elytral length. Punctate area extending 3/5 of way to base and laterad to level of second dorsal stria, the tips of the striae entering the punctures which are coarse and dense. Propygidium coarsely densely punctate; pygidium more finely but densely punctate. Prosternum subcarinate, carina bistriate, the striae attaining neither apex nor base. Protibia 9-tuberculate, the

apical seven more or less dentiform. Type: Cal.

Subg. *Pachylopus* Er.

Saprinus (*Pachylopus*) *palmatus* Say.—This is the name of the species and applies to the black form. *Desertorum* and *deserticola* Mars. are synonyms. Ab. *dimidiatipennis* Lec. applies to the form with the elytra red except at the base.

NOTES ON THE HABITS OF ANTHIDIUM COLLECTUM HUARD.

BY CHARLES H. HICKS,
University of California at Los Angeles.

Dr. Herbert F. Schwarz[1] has recently considered the relationship of *Anthidium collectum* Huard and *A. angelarum* Titus. After a study of the facts at hand, he says: "I think there can be little doubt that the insects represent one species to which the name *collectum* applies by virtue of priority." From a review of the literature there seems to be no record of the nesting habits of this bee.

During the Spring of 1928 *A. collectum*[2] was found quite common at Pasadena and Sierra Madre, California and certain facts in regard to its habits obtained. Many females were observed nesting, a partial account of which is given below. The nest content was secured in a number of instances and a further study later made in the laboratory. The nesting period under observation extended from March 31st to April 15th inclusive but did not necessarily include the earliest and latest dates of activity for other studies encroached upon my time. On April 15th these bees were found especially abundant, hence the nesting period must have extended somewhat, if not considerably, longer. Schwarz states that the males have been taken from May to July and the females from April to June.

When the female begins nesting the evidence points to the fact that she uses a deserted tunnel or cavity of some other insect or a spider nest in the ground. The evidence in the latter instance appears especially suggestive since her nest of down has many times been found in a cavity above the empty egg case of a spider. One, in addition to the egg case of the spider within, contained to the outside a web, with pebbles held together about the orifice of the tunnel.

A nest taken April 14th had been placed in a tunnel with smooth, even walls, showing that the tunnel had been excavated many days previous when the soil was wet. The cells extended for 28 mm. of its length above which were a few millimeters of pebbles to the outside and 5 mm. of space beyond being filled at the time the activity of the bee was cut short. The outer diameter of the tunnel was 5 mm. as was also that of several millimeters of tunnel which extended, empty below the nest. The width of the tunnel was greater and the walls less smooth in the region containing the cells of this bee, facts suggesting that *A. collectum* may have enlarged the width of an already existing tunnel.

Many females were, in addition, followed as they flew low over the ground, searching for a suitable place in which to form their cells. They were found to enter many tunnels and cavities, hastily leaving those already in use, remaining about the more desired empty ones and finally starting a nest. The tunnel was

1.—Notes on Some Anthidiine Bees of Montana and California. Amer. Mus. Novitates, No. 277, pp. 3-4, 1927.
2.—Kindly determined by Professor P. H. Timberlake.

sometimes located beneath the edge of a rock or leaf, or again, out in the open.

The cell is constructed of down, there often being a few millimeters of the "wool" beneath the base of the cell in which the pollen and honey is placed, between the two cells in case there are more than one and a varying amount above the upper cell and the loose pebbles to the outside. The bee has been seen obtaining the down from the under side of the leaves and along the stem of *Artemisia tridentata*. On May 15th many females were observed gathering this material from plants at East Pasadena. The bee took from one to three minutes to secure a round ball of it, constituting a load. The material was scraped with the mandibles, resulting in a low, audible sound as the jaws moved on the live leaves. The abdomen of the bee was curved beneath her, thus assisting in holding the loose down as it was removed, before the more compact ball was formed. It was then carried away, grasped by the mandibles. Whether or not the fore legs assisted in holding it could not be ascertained. The bee usually worked downward on a stem or leaf, although this procedure sometimes varied a little.

One can often determine if cotton-user bees have been active in an area by inspecting the leaves of plants bearing abundant hairs and locating the sharply constrasting regions on the plant. Beside this contrast there may often be found half formed balls of down, still clinging to the leaf and which for some reason the bees have abandoned.

The nest of down has been found to consist of one or two cells, the mass composing it varying somewhat in size and depending largely on the tunnel or cavity appropriated. The length measures from 14 to 28 mm. and the width from 7 to 16 mm. The cell is provisioned with pollen and honey of the consistency of thick molasses. A clear, light egg, somewhat curved is half buried in the mass on the flat, upper surface.

After the last ball of down has been carried the bee fills up the space between the nest and the surface with small objects found on the ground near-by. Although this usually consists entirely of pebbles, at times pieces of stem, leaves, and the like, are carried in addition. The space to be filled varies and has been found to be from 11 to 40 mm. in length. Since the bee was always caught for identification before this space was entirely filled the maximum number of pebbles, representing separate trips, has not been recorded. The largest number counted from a single nest, which was very nearly the total in this instance, has been 325.

There is some variation among different individuals as to the distance from the nest traversed in order to secure pebbles. Some bees gather them from a rather definite small area but usually they are taken at different points radiating from the tunnel. The distance has varied from an half inch to fifteen feet, the average probably being about a foot. The bee often rejects a pebble in her search, as many as fifteen having been grasped and released on one trip before a suitable one was carried to the nest. Occasionally she attempts to carry one too large and is compelled to drop it on the way or comes heavily to earth partially or completely overbalanced as she reaches the surface.

The pebble is carried with the mandibles and is usually released on the wing as the bee hovers for a moment above the opening. Sometimes, however, she

alights for a second on the surface at the edge and there releases the pebble before flying for another. A number of time records have been taken and it has been found that *A. collectum* averages ten pebbles each minute. The minute includes also the few seconds spent within the tunnel to arrange the pebbles in place, a phase of her activity which again varies but which often takes place after every eight or ten trips.

One female found nesting was seen to drive away a parasitic bee, *Dioxys producta* (Cress.)[3], which was displaying undue attention to her tunnel. These parasitic bees have been observed quite commonly in the nesting areas of *A. collectum* where they flew low over the ground, entering tunnels and doubtless seeking nests in which to deposit their eggs.

Nesting females of *A. collectum* have been taken at the flowers of *Lotus scoparius* and Schwarz has reported from a letter from Professor P. H. Timberlake that she visits at Riverside, *L. glaber* and *Phacelia distans*. While observing one here collect from *L. scoparius*, a male alighted upon her, both falling to the ground. The male was well back on the female and after a few seconds copulation took place, lasting twenty-five seconds. The pair was secured when they separated and started to fly away. Another pair was later likewise observed but further details were not secured.

Both males and females have been found resting and sleeping in cavities in wood. Two males and one female were found together in a tunnel of an old stem of wild tobacco, *Nicotiana glauca*, late one afternoon in April. The weather was cool and the sky partly overcast. These individuals were rather inactive, allowing me to take them readily and only feebly attempting to escape.

STUDIES IN THE SCARABAEIDAE (II).*

BY W. J. BROWN,
Ottawa, Ont.

Onthophagus blatchleyi n. sp.

Length 6-7.2 mm.; width 3.6-4.2 mm. Broadly oval; black, opaque above except as noted below, ventral surface and legs shining; pronotum and elytra with short, sparse, pale setae; venter with a few hairs. Head slightly more than half as wide as pronotum; genae not prominent.

Pronotum one-half wider than long; surface finely alutaceous; granulate, the granules rather sparse, shining, rounded in form, each supporting at its base a short, erect, pale seta; base without marginal line.

Elytra one-half wider than length of elytral suture, the sides moderately arcuate. Striae fine, with well spaced, fine punctures. Intervals finely alutaceous: the sutural with a single row, the others with two or three irregular rows of very small, rounded, shining, granules; a short, pale seta arising behind each granule. Apical elytral margin usually with several small testaceous spots.

Pygidium alutaceous and opaque in basal half, shining and coarsely punctate in apical half. Metasternum and femora coarsely and sparsely punctured.

Male. Head except front and vertex shining: clypeus with a few coarse

3.—Determined by Professor P. H. Timberlake.

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

punctures and traces of rugae on the sides, the anterior margin produced into a reflexed triangular tooth which is narrowly rounded at apex. Genae with a few coarse punctures. Clypeal carina distinct; carina of vertex obsolete at middle, except in effeminate males, and represented on each side by a transverse, usually feeble tubercle. Anterior declivity of pronotum shining, without granules; pronotal process about one-third as wide as pronotum, as long as wide in the type, the sides parallel, the anterior margin rather strongly and broadly emarginate on each side and more narowly and less deeply emarginate at middle.

Female. Clypeus rugose and shining; genae with a few punctures and traces of rugae; front with a few small granules; the head with two simple, strong carinae. Pronotal process represented by a low, shining tubercle on each side; the disk alutaceous and granulate to the apical margin.

Holotype.— ♂, Royal Palm Park, Fla., April 6, 1925, (W. S. Blatchley); No. 2870 in the Canadian National Collection, Ottawa.

Allotype.— ♀, Dunedin, Fla., March 16, 1925, (W. S. Blatchley).

Paratypes.—2 ♂, 1 ♀, same data as holotype; 1 ♂, same data as allotype.

This species is closely allied to *hecate*. In *hecate* the dorsum is feebly shining; in *blatchleyi* it is opaque. The pronotal granules are elongate in form and closely spaced in *hecate;* in *blatchleyi* these granules are circular in form and sparsely placed. The pronotal hairs are much shorter in *blatchleyi*. The author has seen no specimens of *hecate* in which the anterior margin of the male pronotal process is tri-emarginate as is the case in three of the males of *blatchleyi* at hand. In the fourth male of *blatchleyi* an effeminate individual, this margin is simply arcuately emarginate as in feeble males of *hecate*. It is only rarely that the pronotal process is represented in the female *hecate* by two simple tubercles. However, the value of these sexual characters must remain uncertain until more specimens of *blatchleyi* are available.

Aegialia crassa insularis n. subsp.

This form differs from typical *crassa* in the puncturation of the pronotum. In typical *crassa*, the pronotum is very distinctly punctate. The punctures are coarse and deep on the basal half and become fine on the apical half. In *insularis* the punctures are fine and very feebly impressed and are confined to the basal half of the pronotum; the apical half is without sculpture. The pronotal sides are impunctate in *insularis* as in typical *crassa*.

Holotype.—Queen Charlotte Islands, (J. H. Keen); No. 2871 in the Canadian National Collection, Ottawa.

Paratypes.—8, same data.

Aphodius edmontonus n. sp.

Length 3.8-4.4 mm.; width 1.8-2 mm. Oblong, moderately convex and elongate, parallel. Head and pronotum black, the anterior angles of the latter not paler; elytra and legs dark reddish brown; venter blackish; surface shining.

Head seven-tenths as wide as pronotum, moderately convex; frontal suture with three very feeble tuberosities; surface punctate; the punctures close and moderately close in front, fine and sparse on the vertex. Clypeus broadly, not deeply emarginate, broadly rounded on each side of the emargination, the sides oblique. Genae rectangular, moderately prominent.

Pronotum three-fourths as long as wide, widest just behind the middle; the sides feebly arcuate, fimbriate with moderately short hairs; hind angles very obtuse but distinct; base almost evenly arcuate, fimbriate except at middle, the marginal line very fine but entire. Disk sparsely punctate with fine and moderately coarse intermixed punctures, the larger punctures absent on anterior half at middle, the puncturation scarcely closer on the sides. Scutellum finely punctate.

Elytra at base equal in width to the pronotum, very slightly wider posteriorly, the basal margin except at middle and side margins in basal half fimbriate like the pronotum. Disk rather coarsely striate, the striae with moderately close, feeble punctures; intervals feebly convex, sparsely and very finely punctate, the sides not crenate.

Mesosternum alutaceous, the intercoxal process not carinate. Metasternum with a few fine punctures at middle, sparsely and rather coarsely punctate on the sides. Abdomen finely and sparsely punctate, very feebly alutaceous. Anterior tibia tridentate, the margin crenate above the upper tooth. Middle and hind femora each with a few very fine punctures and with several coarse punctures near apex. Hind tibia fimbriate at apex with short, subequal spinules; the first segment of hind tarsus equal in length to the two following.

Male. Anterior tibial spur equal in length to the first two tarsal segments, moderately stout, gradually attenuate to apex. Minor spur of middle tibia about half as long as the major, slightly curved near apex.

Female. Anterior tibial spur slightly more slender, otherwise as in the male. Minor spur of middle tibia as in the male but straight.

Holotype.—Edmonton, Alta., April 14, 1924, (O. Bryant); No. 2867 in the Canadian National Collection, Ottawa.

Allotype.—Same data as holotype.

Paratypes.—2 ♂, Edmonton, Alta, April 14, 1924 and May 1, 1925, (O. Bryant).

This species is a member of Horn's group B. It is allied to *putridus* but differs from this by its small size, fimbriate elytral and pronotal margins, and sculpture. Two allies, *bryanti* and *duplex* are equally small and are similar in color. The close puncturation of the head and pronotum distinguish *bryanti*, and the clypeal carina separates *duplex* from the present species; in neither of these are the marginal fimbriae consicuous as is the case in *edmontonus*.

Aphodius bryanti n. sp.

Length 3.6-4.7 mm.; width 1.7-2.2 mm. Oblong, moderately convex and elongate, parallel. Head and pronotum black, the anterior angles of the latter not paler; elytra, abdomen, and legs very dark reddish brown; ventral thoracic sclerites black; surface shining.

Head two-thirds as wide as pronotum; moderately convex; the frontal suture with three tuberosities which are usually very feeble; clypeus sometimes with feeble trace of a transverse carina. Head coarsely punctate, the sculpture very dense and rough on sides and anterior third, moderately close posteriorly. Clypeus broadly and shallowly emarginate, very broadly rounded on each side

of emargination, the sides moderately arcuate. Genae very broadly rounded, moderately prominent.

Pronotum three-fourths as long as wide, widest near base; the sides feebly arcuate in basal two-thirds, rather strongly so anteriorly; basal angles broadly rounded and very obtuse; basal marginal line strong and entire. Disk moderately closely punctate, the punctures unequal in size and almost evenly distributed. Scutellum with a few punctures.

Elytra at base subequal in width to the pronotum, slightly wider posteriorly. Disk rather coarsely striate; the striate with moderately close and coarse punctures; intervals feebly convex, very finely and sparsely punctate, the sides feebly crenate.

Mesosternum alutaceous, the intercoxal process not carinate. Metasternum finely and very sparsely punctate at middle, more closely and coarsely so on the sides. Abdomen alutaceous, finely punctate. Anterior tibia tridentate, the margin crenate above the upper tooth. Middle and hind femora very finely and sparsely punctate, each with coarse, hair-bearing punctures along the anterior margin and near the apex. Hind tibia fimbriate at apex with short, equal spinules; first segment of hind tarsus slightly longer than the two following.

Male. Anterior tibial spur stout. Median cephalic tubercle often larger than the lateral tubercles.

Female. Anterior tibial spur moderately stout but more slender than in the male. Cephalic tubercles all very feeble.

Holotype— ♂, Calgary, Alta., May 29, 1924, (O. Bryant); No. 2862 in the Canadian National Collection, Ottawa.

Allotype— ♀, same data.

Paratypes.—63, Calgary, Alta., May 9 and 29, 1924, (O. Bryant).

This species is closely allied to *manitobensis* and *duplex*. It differs from the former of these by its smaller size, more roughly sculptured head, more coarsely punctate pronotum, and by the sexual characters. In *duplex*, the cephalic tubercles and carina are much stronger; the clypeus is less roughly punctate; the pronotum is much more convex; the pronotal punctures are more unequal in size; and the elytral intervals are more finely punctate than in the present species. The sculpture of the head and pronotum of *bryanti* approaches that of the female of *distinctus*. In one male paratype of *bryanti* the elytra and legs are pale reddish-brown throughout.

Aphodius carri n. sp.

Length 3.4-4.3 mm.; width 1.6- 2 mm. Oblong, moderately convex and elongate, parallel. Head black, the anterior and side margins reddish brown; pronotum black, the anterior angles reddish brown; elytra and legs reddish brown; ventral surface dark reddish brown or blackish; surface shining.

Head seven-tenths as wide as pronotum; moderately convex, without tubercles or carina; finely alutaceous and moderately closely, evenly, and finely punctate, the punctures of the vertex a little coarser. Clypeus broadly, rather shallowly emarginate, the angle on each side rounded and very obtuse; the sides scarcely arcuate. Genae broadly rounded, moderately prominent.

Pronotum two-thirds as long as wide; moderately convex; the sides almost parallel, almost vertical in posterior half, becoming explanate anteriorly,

broadly and rather strongly so at the front angles which are very obtuse and broadly rounded; hind angles obtuse and broadly rounded; basal marginal line entire, the basal margin arcuate and feebly crenate. Disk closely punctate with intermixed coarse and fine punctures, the punctures becoming shallow and more or less confluent near the side margins where the surface is usually finely alutaceous. Scutellum impunctate.

Elytra at base subequal in width to the pronotum, slightly wider posteriorly; humeri strongly dentate. Disk deeply and sharply striate, the striae with well spaced punctures which crenate the elytral intervals; intervals moderately convex, sparsely and very finely punctate.

Mesosternum punctate, alutaceous and subopaque, the intercoxal process smooth, shining and not carinate. Metasternum finely and sparsely punctate. Abdomen finely alutaceous, finely and sparsely punctate. Ventral face of anterior femur impunctate and without hairs; anterior tibia strongly tridentate, the teeth broader than usual, the anterior face impunctate; first segment of anterior tarsus longer than the second. Middle and posterior femora finely and sparsely punctate; the tibiae fimbriate with short, unequal spinules; first segment of hind tarsus slightly longer than the two following.

Male. Anterior tibial spur moderately stout, scarcely curved, extending to the apex of the second tarsal segment. Minor spur of middle tibia stout, about one-third as long as the major, curved near the apex which is bluntly pointed.

Female Anterior tibial spur as in the male. Minor spur of middle tibia about half as long as the major, not curved, the apex acutely pointed.

Holotype.— ♂, New Dayton, Alta., May 19, 1925, (F. H. Strickland); No. 2855 in the Canadian National Collection, Ottawa.

Allotype.— ♀, same data as holotype.

Paratypes.—1 ♂, 3 ♀, same data as holotype; 1 ♂, 1 ♀, Medicine Hat, Alta., May 18, 1928, (F. S. Carr); 3, sex undetermined, Medicine Hat, Alta., June 9, 1928, (F. S. Carr).

This peculiar species is not closely allied to any previously described and does not fit well into any of Horn's groups. On account of the explanate anterior pronotal angles, it is probably best to place the species with those in which the lateral pronotal margins are explanate. In my key to the species of this group (Can. Ent., LX, 12) *carri* traces to couplet 11, but differs from the species included there, and from all other species of the group except the equally aberrant *luxatus*, in having the elytral humeri dentate.

Mr. Carr, from whom I received the species, informs me that Mr. Strickland found it flying about the mouth of a pocket gopher burrow. The specimens collected by Mr. Carr were taken from the burrows of the gopher.

Didactylia d'Orb.

This genus contains species that were formerly included in *Aphodius*. Its essential characters are as follows: front tibia slender, bi- or tridentate externally; middle and hind tibiae triangular in form, gradually widened to apex, compressed, without transverse ridges; abdominal segments connate at middle. In *Aphodius*, the abdominal segments are not connate; the middle and

hind tibiae bear transverse ridges, are rarely compressed, and are usually relatively narrower.

Schmidt (Das Tierreich, lief. 45, 359, 1922) has made *Aphodius knausii* Fall a synonym of the South American *Didactylia notata* Harold, but *knausii* should be restored to specific rank, for it seems unlikely that the range of the species should extend to South America. Moreover, *knausii* and *notata* differ considerably in color. *Aphodius wolcotti* Blatch. cannot be distinguished from and is conspecific with *knausii*. *Aphodius parcus* Horn also belongs to *Didactylia*.

The North American species of *Didactylia* may be characterized briefly as follows:

Basal margin of pronotum scarcely sinuate on each side of middle; color very pale yellow throughout, the elytra not maculate, the head and pronotum at middle slightly darker. Florida, New Jersey, and Georgia (3 specimens) ..... *parca* (Horn).

Basal margins of pronotum distinctly but not strongly sinuate on each side of middle; elytra usually distinctly maculate, much paler than head and pronotum at middle. Englewood and Medora, Kansas; Millers, Indiana. (10 specimens from each locality including 1 from Indiana which has been compared with the type of *wolcotti*) ..... *knausii* (Fall).

Aphodius larreae Horn. and *A. phalcroides* Horn. are closely allied to the species noted above. They possess the habitus and some of the characters of *Didactylia* and are excluded from that genus only on account of their free abdominal segments and transversely ridged tibiae.

Rhyssemus puncticollis n. sp.

Length, 3-3.3 mm.; width, 1.3 mm. Oblong, moderately elongate and convex, parallel. Black, underside of prothorax and legs brown; largely subopaque above, largely shining beneath.

Head two-thirds as wide as pronotum; moderately convex; apical half shining, impunctate, tuberculate, the tubercles granuliform, feebly elevated, and moderately close; this shining tuberculate area attaining the vertex in a median triangular process; genae and adjacent parts of clypeus smooth; posterior half of head opaque, punctate, the punctures coarse, transverse and confluent except at middle of base, where they are not dense; a low, rounded, shining tubercle on each side. Clypeus broadly, moderately deeply emarginate, the angle on each side obtuse but very distinct, the sides scarcely arcuate.

Pronotum three-fourths as long as wide; of usual form, the sides feebly arcuate and crenate, the hind angles obliterated, the base with an entire marginal line, the lateral and basal margins fimbriate with scales. Disk with four shining, transverse ridges all of which are well separated from the lateral margins, the first three parallel and not broken up into granules, the basal ridge more or less broken, the two most basal ridges interrupted at middle by a broad median channel, the third ridge turning and bordering the channel on each side half way to base; the areas between the ridges and at base opaque, coarsely and confluently punctured but without granules; area near apical margin shining, obsoletely granulate; disk near the lateral margins opaque and finely granulate

Elytra at base as wide as pronotum, scarcely wider posteriorly; subopaque; humeri finely dentate. Disk coarsely, not deeply striate; the intervals each with a

row of moderate, oval tubercles nearer the outer margin, the inner margin of each crenate by the well-spaced punctures of the striae and slightly elevated into a small tubercle before each crenation.

Metasternum opaque on each side, shining at middle, with a deep median groove. Abdomen shining, the anterior margin of each segment crenate. Middle and hind femora each with a deep and entire marginal line and punctate near apex. Posterior tarsus with first segment equal in length to the longer spur, shorter than the three following.

Holotype—Toronto, Ontario, May 14, 1925, (L. J. Milne); No. 2789 in the Canadian National Collection, Ottawa.

Paratype—1, Toronto, Ontario, May 22, 1927, (E. C. Oakley).

This species differs from its allies in the sculpture of the head and pronotum. Its elytral sculpture is similar to that of *sonatus*, but the two rows of granules on each interval are more unequal in the present species. The pronotal ridges are more strongly developed than in any other of our species. These characters together with the punctate pronotal depressions render the species very distinct.

Rhyssemus neglectus n. sp.

Length, 3.2-3.5 mm.; width 1.6-1.8 mm. Oblong, moderately elongate and convex, parallel. Black, underside of prothorax, legs and sometimes the abdomen brown; opaque above; largely shining beneath.

Head almost three-fourths as wide as the pronotum; moderately convex; tuberculate throughout, the tubercles granuliform and moderately close, larger and less close at middle except on the vertex; a larger, oval tubercle on each side of vertex. Clypeus broadly, moderately deeply emarginate, the angle on each side obtuse but very distinct, the sides scarcely arcuate.

Pronotum three-fourths as long as wide; of the usual form, the sides not arcuate in front, distinctly crenate; the hind angles obliterated; base with an indistinct marginal line; the base and sides fimbriate with scales. Disk with four transverse ridges which are well separated from the side margins and which are more or less broken up into large, feebly shining granules, the two posterior interrupted at middle, less distinct than the others; disk between the ridges and sides opaque, rather finely and closely granulate.

Elytra at base as wide as pronotum, scarcely wider posteriorly; humeri dentate. Disk coarsely, not deeply striate; the intervals each with a row of round, strongly elevated tubercles nearer the outer margin, the inner margin of each crenate by the well spaced punctures of the striae and feebly elevated before each crenation.

Metasternum opaque on each side, shining at middle, with a deep median groove. Abdomen shining, the anterior margin of each segment crenate. Middle and hind femora each with a deep and entire marginal line and with a few coarse punctures near apex. Posterior tarsus with first segment equal to the long spur and slightly shorter than the three following.

Holotype—Payne Co., Oklahoma, November 29, 1924, (W. J. Brown); No. 2790 in the Canadian National Collection, Ottawa.

Paratypes—2, same data as holotype; 2, Greeley, Colorado; 6, Colorado.

This species is closely allied to *sonatus*. In *neglectus*, the pronotal ridges

are more or less broken up into granules which are very much larger than the granules of the depressed areas. In *sonatus*, the pronotum is almost uniformly granulate throughout, the granules of the ridges being very slightly larger than the others. In *neglectus*, the form is more robust and the granules of the inner row on each elytral interval are very much smaller than in the allied species.

NEW CANADIAN ANTHOMYIDS BELONGING TO THE GENUS HYLEMYIA ROB.-DESV. (MUSCIDAE, DIPTERA).

BY H. C. HUCKETT,
Riverhead, N.Y.

Many new species of the genus Hylemyia Rob.-Desv. are herewith described as a result of a study of Canadian Muscidae in the National Collection at Ottawa. This family is represented by a large number of specimens in the collection, and by a representative number of species belonging to the Canadian zone. No doubt the number will be doubled within the next few years as collecting progresses. It is evident, as the records testify, that the accumulation of this rich collection of anthomyid flies is in no little measure due to the efforts of two enthusiasts, Mr. H. L. Seamans and Mr. C. B. D. Garrett. The writer wishes to make full admission of his indebtedness to these collectors in allowing him the use of their material. He also wishes to acknowledge the aid received from Dr. T. H. Frison and Field Museum of Natural History in the loan of types, and to Dr. A. L. Melander in the use of his collection which contains many of Stein's types of western species. Unfortunately many types of Stein's second list of North American Anthomyiidae (5) have been retained in Europe, rendering it a matter of great uncertainty in the identification of many of his species. It is possible that some of the species herein described as new may be synonyms of Stein's species contained in this list, or they may be European species already described.

Hylemyia crucifera sp. nov.

Male blackish, similar in appearance and general habitus to *planipalpis* Stein. Abdomen densely grayish pollinose, with a black dorsocentral vitta which merges into the incisures at the cephalic margin of each tergum. Wings tinged; veins yellowish brown; calyptrae whitish; halteres yellow.

Head as in *planipalpis*, with five pairs of frontal bristles and an irregular series of less robust bristles on ventral margin of cheek. Palpi nearly filiform. Thorax with acrosticals sparsely set and fine, irregularly paired, with the two cephalic pairs slightly stronger, but remaining setulose. Prealar bristle nearly equal to length of anterior notopleural bristle; the posterior notopleural bristle much shorter than the anterior bristle: post-humeral bristle not duplicated. Abdomen slender, depressed, slightly tapering caudad: hypopygium small, processes of fifth sternum armed with a series of 3 or 4 long bristles on apical half of outer border, the tips of which become very fine and curve inward, frequently to cross one another, the remainder of the surface with sparsely set, fine setulae.

Fore tibia with a weak apical posteroventral bristle and two or one median posteroventral bristles; mid femur with 4 or 5 longish bristles on proximal half of posteroventral surface, anteroventral surface with no bristles; mid tibia with or without a weak anterodorsal bristle, with 1 posterodorsal and 2 or 3 postero-

ventral bristles: hind femur with an entire series of long anteroventral bristles, in length exceeding the diameter of femur; posteroventral surface bare except for 1 or 2 short basal and 2 or 3 short apical bristles; hind tibia with a series of 12 to 16 short setulae on antero- and posteroventral surfaces, the apical 2 or 3 of the former becoming increasingly stout and bristlelike and those of the latter weaker and more appressed, with 4 or 5 uniform anterodorsal and 3 long and 1 short posterodorsal bristle, apical posteroventral bristle absent.

Wings with costal thorn short and stout: *m-cu* cross vein slightly sinuate.

Female very similar to that of *brassicae* Bouché, differing essentially in having the acrosticals very weak and sparse, with no stronger developed presutural pair: posterior notopleural bristle slightly longer than half length of anterior bristle: sternopleurals, 1:1. Abdomen densely yellowish gray pruinose with dark reflections. Fore tibia with 1 median anterodorsal and 2 median posteroventral bristles: mid femur with one basal anteroventral and 2 or 3 basal posteroventral bristles; mid tibia with 1 anterodorsal, 1 posterodorsal and 2 posteroventral bristles: hind femur with 4 or 5 anteroventral bristles, posteroventral surface bare; hind tibia with 4 or 5 anteroventral, 4 anterodorsal, 3 posterodorsal and a short series of appressed setulae on posteroventral surface; apical posteroventral bristle absent. Wings faintly tinged, with veins yellowish; *m-cu* cross vein nearly erect. Length 6 mm.

Records:—1 ♂, Lethbridge, Alta. Aug. 3, 1923 (H. L. Seamans): 1 ♂, Winnipeg, Man., July 18, 1925 (A. V. Mitchener): 1 ♂ Armstrong, B.C., July 12, 1920 (M. H. Ruhmann): 1 ♂ Sask., on grass, June 30, 1917 (A. E. Cameron): 1 ♂ Winnipeg, Man., July 14, 1926 (V. N. Riddle): 1 ♂ Teulon, Man., July 8, 1922 (A. J. Hunter): 1 ♂ Inverness, B.C., July 16, 1927 (A. A. Dennys): 1 ♂ Teulon, Man., July 14, 1924 (A. J. Hunter): 1 ♀ Banff, Alta., June 16, 1922 (C. B. D. Garrett): 1 ♀ Banff, Alta., July 23, 1922 (C. B. D. Garrett).

Type, allotype and *paratypes*, No. 2913 in Canadian National Collection.

This species belongs to the *brassicae* group, which includes *planipalpis, occidentalis,* and *inaequalis*. In the male it may be differentiated by the lack of a basal tuft of bristles on the anterior surface of hind femur, by the peculiar bristling of processes of fifth sternum, by the weak acrostical bristles, and by the series of long bristles on the entire length of anteroventral surface of hind femur. In the female the species is noteworthy for the possession of very weak acrostical hairs, for the arrangement of stenopleurals, 1:1, and for the presence of 4 or 5 anteroventral bristles on hind tibia.

Hylemyia planipalpis Stein.

Records:—1 ♂ Banff, Alta., May 5, 1922 (C. B. D. Garrett): 1 ♂ Victoria, B. C., July 2, 1918 (W. Downes): 1 ♂ Aweme, Man., Aug. 2, 1920 (N. Criddle).

In my opinion this species has been described by Malloch (1) as *Hylemyia anthracodes* (*anthracina* preoc.). It is unfortunate that Stein in designating his type material should have included two species in the series, *planipalpis* Stein and *florilega* Zett. According to Malloch's key (2) the male of *florilega* has been accepted as the type of *planipalpis*. Reference to Stein's description of *planipalpis* (4) will readily indicate which specimens Stein had in mind in erecting the species, since in many important respects the description clearly disagrees

with characters presented in *florilega*. If it is thought necessary to disregard Stein's' designation owing to this irregularity then *anthracodes* Mall. may be maintained as the logical name.

Hylemyia gemina sp. nov.

Male blackish, superficially resembling *uniseriata* Stein, differing essentially in having the presutural acrostical bristles in two series and lacking the strongly developed costal setulae. Head with frontal vitta and parafacials blackish to reddish, the latter together with the cheeks whitish pruinescent. Thorax blackish, faintly shining, viewed from behind with three black vittae: humeral and notopleural areas with lighter shading. Abdomen lightly grayish pollinose, subshining with dark reflections; when viewed from behind each tergum has a black central vitta that expands cephalad along the anterior half. Legs blackish, subshining; pullvilli tinged. Wings smoky, densely so basad; veins chocolate brown; calyptrae whitish; halteres yellow.

Head with eyes separated by a distance scarcely greater than diameter of anterior ocellus; frontal vitta distinctly but narrowly separating parafrontals cephalad of anterior ocellus. Parafrontals with five pairs of bristles and one pair of cruciate setulae. Cheeks and parafacials at base of antennae about equal to breadth of third antennal segment, the latter considerably narrowed ventrad. Thorax with acrosticals in paired series, narrowly separated, usually three presutural pairs which are stronger than the postsutural, the middle or second pair of which is stronger developed than either of the remaining pairs: prealar bristle as long as posterior notopleural bristle; posthumeral bristle duplicated; sternopleurals, 1 or 2: 3. Abdomen depressed, conical, slightly tapering caudad; hypopygium not large, processes of fifth sternum with no hairs or setae on inner margins, the inner borders with a few sparsely set setulae, the outer border with normal bristling increasing in length apicad.

Fore tibia with a median posteroventral bristle and a blunt apical posteroventral bristle: mid femur with 3 or 4 weak bristles on basal third of anteroventral surface, and 7 or 8 long bristles on proximal two-thirds of posteroventral surface, the apical third with a series of much shorter and weaker bristles; mid tibia with 1 anteroventral bristle on apical third, 1 median anterodorsal, 1 or 2 posterodorsal and 2 posteroventral bristles: hind femur with a series of anteroventral bristles, and a series of finer and shorter bristles on proximal half of posteroventral surface; hind tibia with 3 or 4 anteroventral, 4 anterodorsal, 3 posterodorsal bristles, and a short series of setulae on proximal half of posteroventral surface. Fore and hind tarsi about equal in length to their respective tibia, mid tarsus slightly shorter than mid tibia. Tarsal claws and pulvilli large.

Wings with costal thorns distinct but short, costal spines normal, scarcely longer than costal setulae; veins R_{4+5} and M_{1+2} slightly convergent toward wing margin; penultimate section of vein M_{1+2} about half length of ultimate section; *m-cu* cross vein erect.

Female very similar to that of *uniseriata* Stein. In coloration paler and less conspicuously marked than in male. Thorax with two pairs of presutural acrostical bristles; posthumeral bristle not duplicated; sternopleurals, 1:2. Fifth sternum of abdomen with a well developed pair of caudal bristles. Fore tibia with 1 median anterodorsal and 1 posteroventral bristle: mid femur with no bristles on

anteroventral surface, posteroventral surface with 3 or 4 bristles on proximal third; mid tibia with 1 anteroventral, 1 anterodorsal, 2 posterodorsal, and 1 posteroventral bristle: hind femur with 5 anteroventral bristles and 1 or 2 weak bristles on proximal third of posteroventral surface; hind tibia with 2 or 3 anteroventral bristles on apical half, 3 anterodorsal, and 3 posterodorsal bristles, posterior surface with no series of setulae. Wings with veins pale brown, costal thorns and setulae normal, not strongly developed as in *uniseriata*. Length, 5 to 5.5 mm.

Records:—2 ♂ Banff, Alta., May 5, 1922: 1 ♂ June 8, 1922: 1 ♂ June 14, 1922: 2 ♂ June 18, 1922: 1 ♂ June 26, 1922; 1 ♀ June 27, 1922 (C. B. D. Garrett).

Type, allotype and *paratypes*, No. 2914 in Canadian National Collection.

From *uniseriata* Stein the species may be separated in both sexes by the presence of paired presutural acrosticals, and by the lack of stoutly developed costal spines. In common with *uniseriata* the species possesses an anteroventral bristle on foretibia; and a partial series of posteroventral setulae on hind tibia. A male of the above series has the eyes closely approximate, with the parafrontals contiguous cephalad of the ocellus.

(To be continued)

BOOK NOTICE

Contribution Toward a Monograph of the Adelginae (Phylloxeridae) of North America. By P. N. Annand. 146 pp. Stanford University Press, Stanford, California, 1928.

The author figures and describes all the known American species and reviews the existing literature. He makes several new contributions to the biology and the classification of the nsects of this interesting and difficult group. The seven genera erected by Börner are reduced to two, *Adelges* and *Pineus*. The following new species are described, *Pineus börneri, Pineus sylvestris, Pineus boycei, Pineus engelmanni, Adelges oregonensis, Adelges diversis, Adelges aenigmaticus*. The work is splendidly illustrated and contains a generic key to both the apterous and the alate forms. The book is of interest to the general biologist as well as to specialists; it will no doubt be very useful to forest entomologists.

J. J. De Gryse.

Montreal, Monday, April 29th, 1929.